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Full Length Research Paper

Periods of competition between weeds and soybean crop in Cerrado

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This paper aimed to identify the periods of weed interference in soybean cultivar P98Y12, in the 2011/2012 harvest. The importance of this paper is that soybean is a commodity of great participation of the Brazilian economy and one of the largest contributions in the balance of exports. The assay was carried out in Oxisol, in the town of Campo Grande, Mato Grosso do Sul state, Brazil. The experimental design was a randomized block with four replications and fifteen treatments that consisted of periods of coexistence between the weeds and the crop. Additionally, phytosociological research was performed among the weeds. Under the conditions of the assay the Period Previous to Interference (PPI) was recorded at 7 DAE, the Critical Period for Prevention of Interference (CPPI) between 7 and 42 DAE and the Total Period for Prevention of Interference (TPPI) between emergence and 42 DAE. The infestation that occurred in the experimental area caused 90.42% of losses in grain yield. The weed species that showed the highest Importance Value Index (IV) were *Digitaria horizontalis* (94.2%) and *Ipomoea grandifolia* (71.9%).

Key words: *Glycine max*, grain production, productivity, weed competition, weed control, Brazil.

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is the most cultivated oleaginous crop in the world and one of the most commercialized commodities around the globe. According to Conab (2014), Brazil alone produced 86 million tons of this grain during the 2012/2013 harvest, in an area of approximately 30.1 million hectares, making the country the second largest producer of soybean worldwide. As with all crops, in order to achieve successful results and high grain yield, it is necessary to apply efficient and cost-effective production systems. Among many factors that integrate the production system, the management and control of weeds stand out, since the inefficient handling these, might decrease production (Pereira, 2004).

Pitelli (1985) classifies weeds as being those that emerge spontaneously in agricultural ecosystems, causing a series of interferences with the cultivated plants, which not only compromise productivity but also the execution of a chosen production system. Because of its soil and climate conditions, Brazil stands out as a

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country with a vast potential for soybean cultivation. However, the tropical climate is also very favourable to many weed species that interfere in the development and productivity of crops (Barros et al., 2000).

Weeds are competitive plants with aggressive characteristics that help them thrive and adapt to disturbed environments. Some of these features are the capacity to produce large quantities of seeds that can be easily disperse and have a long lifespan; and also their efficient propagation mechanisms, such as rhizomes and tubercles, that can endure long periods in soil (Lorenzi, 2008).

Oliveira Jr. et al. (2011) state that grain yield and profit in soybean cultivation are limited by weed interference, which tends to raise production costs, reduce profit margin and lower the quality of the product. Therefore, in order to manage these issues, it is necessary to study and determine the periods during which a crop can tolerate coexistence with weeds (Pitelli and Durigan, 1984).

In studies carried out by Silva et al. (2008), Costa et al. (2008) and Briguenthi and Briguenthi (2009) the critical periods of coexistence were established for weeds in annual crops. However, the values obtained were not agreed upon by the different authors. This lack of a pattern occurs due to the different development conditions in which the studies were conducted (crop, cultivar, management, cultivation system, soil and climate conditions, as well as specific compositions of weeds).

To measure the level of interference of the invader species, Pitelli and Durigan (1984) proposed the following concepts: period previous to interference (PPI), critical period for prevention of interference (CPPI) and total period for prevention of interference (TPPI). The PPI is the period in which, after emergence, the crop coexists with the invaders before its productivity, or other characteristics, are negatively affected. The CPPI is defined as the period of the cycle when the coexistence between the crop and weeds decreases productivity of the cultivated plants. The TPPI is the period after emergence in which the crop should be kept free of weeds so that its productivity is not negatively affected (Pitelli, 2014). This study aimed to identify the periods of interference of weeds in the soybean crop, cultivar P98Y12, under soil and climate conditions found in the Cerrado (Brazilian savannah), in order to provide helpful information that would optimize the soybean production.

MATERIALS AND METHODS

This study was carried out in Oxysol, with clay texture and slightly undulating relief, in the municipality of Campo Grande (Mato Grosso do Sul state, Brazil), during the harvest of 2011/2012. The statistical design adopted was random blocks with 4 repetitions and 15 treatments. The treatments were constituted by periods of coexistence between the infesting community and the crop, being of: 0, 7, 14, 21, 28, 35, 42, 49, 56, 70, 84, 98, 112, 126 and 133 days after emergence (DAE). At the end of each period of coexistence the invaders were eliminated from the sample area until harvest, by manual hoeing.

Each plot was 3.0 m in width by 5.0 m in length. The Soybean cultivar P98Y12, with a medium cycle and certain growth habit, is recommended for the region, according to Fundação (2012). The experimental area was fertilized with 300 kg.ha^{-1} of 00-20-20 formula. On the 11th of December, 2011, it was executed mechanical sowing, with 45 cm left between rows and 19 seeds per linear meter in a minimum-cultivation system. After germination, which occurred on the 17th of December, 2011, manual thinning was carried out so that 16 seedlings would remain per linear meter, obtaining a population equivalent to 355,500 plants.ha^{-1}. In order to characterize and carry out the phytosociological study of the invaders, a square (0.5 m x 0.5 m) was used as a sampling unit, which was set up randomly within each plot, before controlling the invaders from each period of coexistence. In each sample, the weeds were counted, weighed and identified, according to family, genus, species and common name.

Based on the numbers obtained on the count and classification, it is possible to determine a series of figures proposed by Mueller-Dombois and Ellenberg (1974): density (D), frequency (F), abundance (A), relative density (Dr), relative frequency (Fr), relative abundance (Ar) and importance value index (IVI).

During manual harvesting of the used area of the plots, which occurred on the 4th of May, 2012, it was registered the number of plants per linear metre, the number of pods per plant and the number of grains per pod, as well as the production of pods and grains. Based on the regression curves and the Tukey test at 5% probability, the PPI, TPPI and, by the difference, the CPPI of the weeds in the soybean crop were calculated.

RESULTS AND DISCUSSION

It was identified five families and eight species of weeds, as shown in Table 1. The species *Digitaria horizontalis* from the *Poaceae* family and *Ipomoea grandifolia* from the *Convolvulaceae* family both stood out; presenting high values for the IVI (importance value index), 94.2 and 71.9 respectively. The density results of the same species were also relevant, showing 11.5 plants.m^{-2} of *Digitaria horizontalis* and 8.2 of *Ipomoae grandifolia*.

As indicated on Figure 1, along the periods of coexistence there was an expected increase in the weight of weed dry matter, and the weed growth rate started to decrease and stabilized from the 56th DAE, according to the Tukey's analysis. This happened due to the closing of the crop, which occurred at 46 days after emergence, causing shade and reducing the competitive capacity of the invaders.

On the other hand, the maximum grain yield occurred when there was absolutely no coexistence with the invaders, resulting in 3,248.2 kg.ha^{-1}. From then on, there was no significant difference in this production until the seventh day of coexistence. Therefore, the period previous to interference, in these conditions, was recorded as being from emergence until the seventh day after emergence. However, Meschede et al. (2004) recorded the PPI as lasting until the 11th DAE, when the main infesting flora was *Euphorbia heterophylla*.

Following the Tukey test (Figure 1) it was observed that from the 42nd DAE there were no further significant

Table 1. Phytosociological characteristics of weeds, classified by family. Campo Grande-MS, 2012.

Species	D	F	A	Dr	Fr	Ar	IVI
Poaceae							
Digitaria horizontalis	11.5	100.0	39.0	38.8	16.4	39.0	94.2
Eleusine indica	1.6	60.0	5.4	5.4	9.8	5.4	20.7
Brachiaria decumbens	3.2	90.0	10.8	10.8	14.8	10.8	36.4
Convolvulaceae							
Ipomoea grandifolia	8.2	100.0	27.8	27.7	16.4	27.8	71.9
Ipomoeae nil	1.4	50.0	4.7	4.7	8.2	4.7	17.7
Asteraceae							
Bidens pilosa	1.4	80.0	4.7	4.7	13.1	4.7	22.6
Commelinaceae							
Commelina benghalensis	1.1	60.0	3.7	3.7	9.8	3.7	17.3
Amaranthaceae							
Amaranthus deflexus	1.1	70.0	3.7	3.7	11.5	3.7	18.9

D = Density (plants.m^{-2}), F = Frequency (%), A = Abundance (%), Dr = Relative density (%), Fr = Relative frequency (%), Ar = Relative abundance (%) and IVI = Importance Value Index.

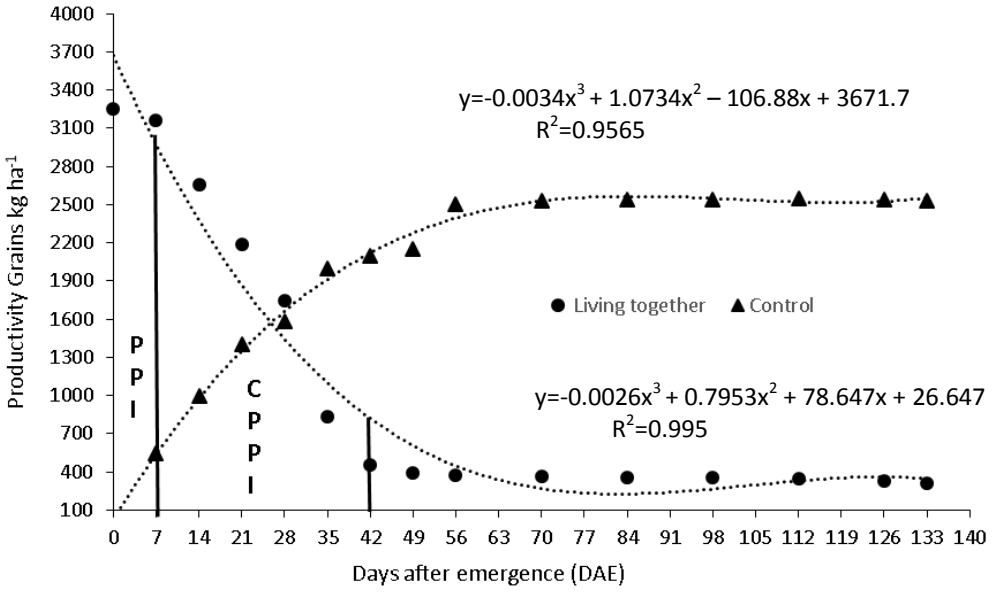


Figure 1. Productivity of soybean grains of living together and Control in function of the periods of coexistence with weeds (DAE).Campo Grande-MS. 2012.

differences in relation to subsequent treatments, which indicates the end of the TPPI, since from the emergence until this period it was possible to prevent the interference from weeds in the soybean crop. It is known that TPPI = PPI + CPPI, therefore the Critical Period for Prevention of Interference (CPPI) was considered to be from the 7th to the 42nd DAE. Under conditions of lower infestation, however, Meschede et al. (2004) indicates that the CPPI lasts from 17 until 44 days after emergence.

After the periods of interference were defined, it was noted that until the end of the TPPI (42 DAE) there was a linear decrease in grain yield and a linear increase in the

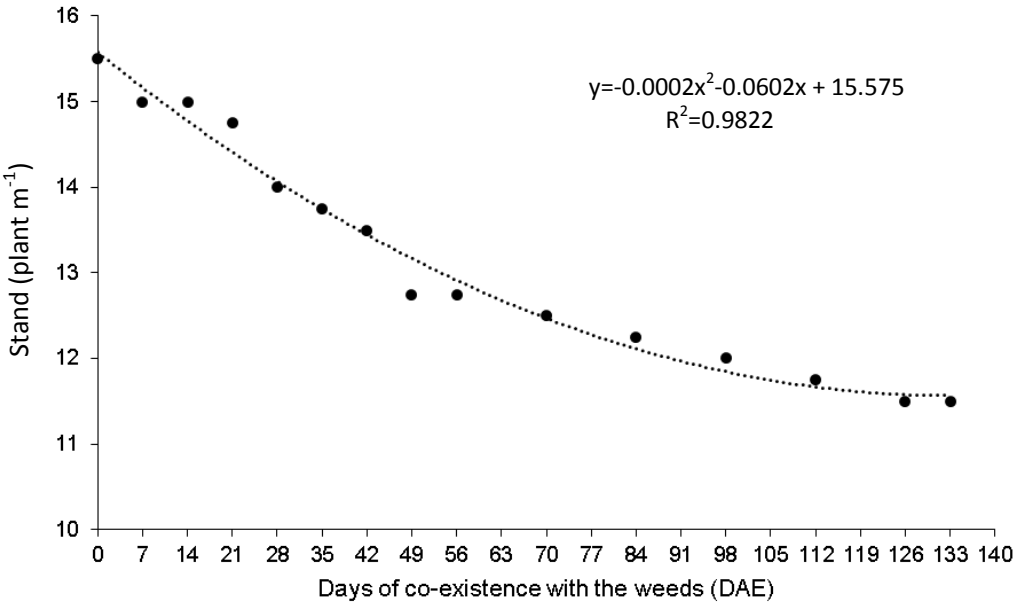


Figure 2. Effect of different periods of coexistence with weeds in the soybean crop on plant stand. Campo Grande-MS, 2012.

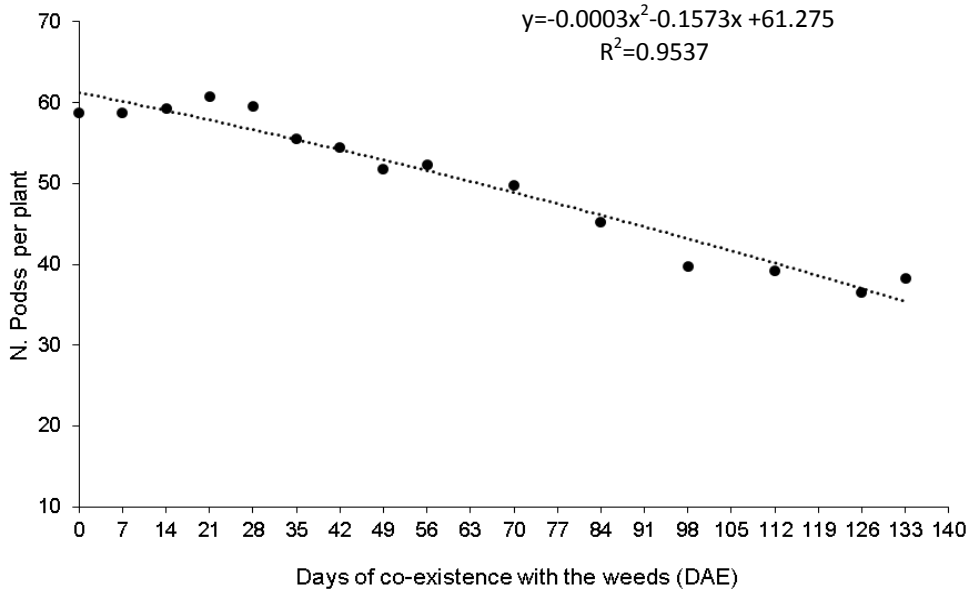


Figure 3. Effect of different periods of coexistence with weeds in the soybean crop on number of pods per plant. Campo Grande-MS, 2012.

dry mass of weeds. Meschede et al. (2004) obtained a daily loss of 6.45 kg.ha^{-1} with a density of 25 plants.m² of the specie *E. heterophylla*, while Pereira (2004) obtained a daily drop of 16 kg.ha^{-1} with an predominant infestation of *Bidens pilosa*.

This matches the data found by Blanco (1985), which stated losses between 42 to 95%, and contradicts the data by Lorenzi (2008), which indicated interference of 30 to 40%. The competition of *E. heterophylla* in studies carried by Meschede et al. (2004) reached a maximum of 38% loss. The crop stand was significantly compromised by the competition with the invaders. It dropped from 15.5 plants per linear metre to 11.50 (Figure 2). These values were similar to the data found by Meschede et al. (2004).

There was also a significant difference on the number of pods per plant (Figure 3), changing from 58.75 to

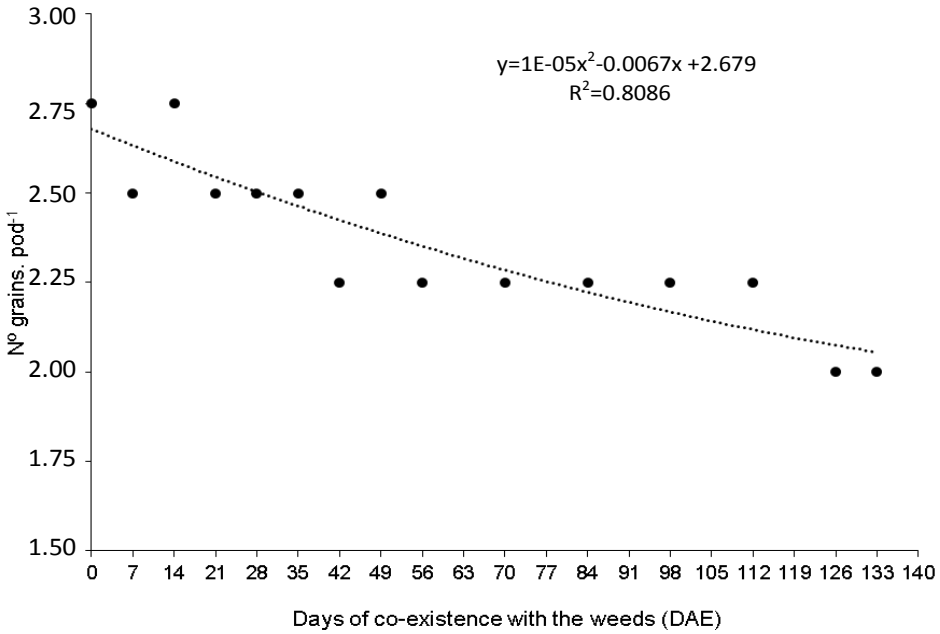


Figure 4. Effect of different periods of coexistence with weeds in the soybean crop on number of grains per pod. Campo Grande-MS, 2012.

38.25 between day 0 and day 133 after exposure of the crop to weeds. Oliveira Jr. et al. (2011) also observed a significant drop in the number of pods per plant (Figure 4). There was no significant change in the average number of grains per pod, nevertheless the grain yield was seriously compromised, reaching 310 kg ha^{-1}, during critical competition along the complete crop cycle.

Conclusions

It was concluded that the Period Previous to Interference (PPI) was from crop emergence until 7 days later; the Critical Period for Prevention of Interference (CPPI) was from 7 to 42 DAE and the Total Period for Prevention of Interference (TPPI) was from emergence until 42 DAE. The weeds that presented the highest Importance Value Index (IVI) were *Digitaria horizontalis* (94.2) and *Ipomoea grandifolia* (71.9), from the families Poaceae and Convolvulaceae, respectively. The infestation conditions studied caused up to 90.42% in productivity loss.

Conflict of Interest

The authors have not declared any conflict of interest.

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REFERENCES

Barros AC, Ueda A, Schumm KC (2000). Eficiência e seletividade do lactofen em mistura com outros latifolicidas, no controle de plantas daninhas na cultura da soja. Rev. Bras. Herbicidas 1(1):79-84.

Blanco HG (1985). Ecologia das plantas daninhas - competição de plantas daninhas em culturas brasileiras. In: BLANCO, H. G. Controle integrado de plantas daninhas. 2.ed. São Paulo: CREA. pp. 42-75.

Briguenti AM, Briguenti DM (2009). Controle de plantas daninhas em cultivos orgânicos de soja. Ciência Rural. 39(8):2315-2319.

CONAB - Companhia Nacional de Abastecimento (2014). Acompanhamento da safra brasileira de grãos (safra 2013/14), 1(9). Brasília: Conab.

Costa NV, Cardoso LA, Rodrigues ACP (2008). Períodos de interferência de uma comunidade de plantas daninhas na cultura da batata. Planta daninha. Viçosa. 26(1).

Fundação MS (2012). Tecnologia e produção: Soja e Milho 2012/2013. Maracaju: Fundação MS.

Lorenzi H (2008). Plantas daninhas no Brasil: terrestres, aquáticas, parasitas e tóxicas. 4. ed. Nova Odessa, SP. Instituto Plantarum.

Meschede DK, Oliveira JR, Constantin J, Scarpim CA (2004). Período anterior a interferência de plantas daninhas em soja com baixo estande. Planta Daninha 22:2.

Mueller-Dombois D, Ellemberg H (1974). Aims and methods of vegetation ecology. New York: John Willey & Sons.

Oliveira Jr RS, Constantin J, Inoque MH (2011). Biologia e manejo de plantas daninhas. Curitiba: Ominipax.

Pereira FAR (2004) Manejo integrado de plantas daninhas no cerrado. A Granja. Porto Alegre. pp. 71-73.

Pitelli RA (1985). Interferência das plantas daninhas em culturas agrícolas. Informe Agropecuário 11:16-27.

Pitelli RA (2014). Competição entre plantas daninhas e plantas cultivadas. In: Aspectos da biologia e manejo das plantas daninhas, Monquero, PA (org). São Carlos: Rima Editora.

Pitelli RA, Durigan JC (1984). Terminologia para períodos de controle e de convivência das plantas daninhas em culturas anuais e bianuais. In: Congresso Brasileiro de Herbicidas e Plantas daninhas, 15, Belo Horizonte.

Silva AF, Ferreira EA, Concenço G, Ferreira FA, Aspiazu I, Galon L, Sediyama T, Silva AA (2008). Densidade de plantas daninhas e épocas de controle sobre os componentes de rendimento da soja. Planta Daninha. Viçosa. 26:65-71.